RRA- EMIESS24C182ECH-04Av0

Radio test report

According to the standard:

CFR 47 FCC PART 15

RSS 247 – Issue 2

Equipment under test:
CRT.0036.915

FCC ID: *2A2B4-36915V3-2*
IC NUMBER: *32334-36915V3*

Company:

E-CHRONOS SA

Distribution: Mr WAELTI Gabriel **(Company: E-CHRONOS SA)**

Number of pages: 14

Ed.	Date	Modified Page(s)	Technical Verification and Quality Approval Name and Function / Visa
0	18-Jul-24	Creation	J.C. BOGA, Laboratories Manager

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Information in italics are declared by the manufacturer/customer and are under his responsibility

S51 RTY 000 INT 00015 [03]

DESIGNATION OF PRODUCT:	***CRT.0036.915***
Serial number (S/N):	*Sample 1: 00372585 / 0033* *Sample 2: 00372566 / 0064*
Reference / model (P/N):	*CRT.0036.915*
Firmware version:	*1.13.5*
MANUFACTURER:	*E-CHRONOS SA*

COMPANY SUBMITTING THE PRODUCT:

Company:	*E-CHRONOS SA*
Address:	Rue d'Airmont 5, 2900 Porrentruy, Switzerland
Responsible:	Mr WAELTI Gabriel
DATE(S) OF TEST:	From 6-Jun-24 to 8-Jun-24
TESTING LOCATION:	EMITECH LYON laboratory at CHASSIEU (69) FRANCE FCC Accredited under US-EU MRA Designation Number: FR0013 Test Firm Registration Number: 807590 ISED Accredited under CANADA-EU MRA Designation Number: FR0007 Industry Canada Registration Number: 4379D
TESTED BY:	T. LEDRESSEUR **VISA:** 
WRITTEN BY:	T. LEDRESSEUR

CONTENTS

REVISIONS HISTORY

Revision	Date	Modified pages	Modifications
0	**18-Jul-24**	/	Creation

1. INTRODUCTION

This report presents the results of radio test carried out on the following radio equipment: **CRT.0036.915**, in accordance with normative reference.

The equipment under test is a LoRa radio module
This report is a justification statement for antenna.

2. PRODUCT DESCRIPTION

Category of equipment (ISED): I

Class: B

Utilization: Residential use

Antenna type and gain: Four different antenna can be used:

Type	Gain (declared)
½ λ whip antenna	2.15 dBi
Omni-directional antenna	3 dBi
Patch antenna (PCB)	1.9 dBi
Internal ceramic antenna	2.15 dBi

Operating frequency range: From 902 MHz to 928 MHz

Number of channels: 20

Channel spacing: 1.288MHz

Modulation parameters: SF=9, BW=500k, CR=2

Power source: 3.3 Vdc

Test frequencies:

Frequencies tested:

Sample N°= 1 ⇨ 902.764 MHz Full tests
Sample N°= 1 ⇨ 915.644 MHz Full tests
Sample N°= 1 ⇨ 927.236 MHz Full tests

Power level, frequency range and channels characteristics are not user adjustable.
The details pictures of the product and the circuit boards are joined with this file.

3. NORMATIVE REFERENCE

The standards and testing methods related throughout this report are those listed below.
They are applied on the whole test report even though the extensions (version, date and amendment) are not repeated.

CFR 47 FCC Part 15 (2024)	Radio Frequency Devices
ANSI C63.10	2013 Procedures for ComplianceTesting of Unlicensed Wireless Devices.
558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules.
RSP-100	Issue 12, August 2019 Certification of Radio Apparatus and Broadcasting equipment
RSS-Gen	Issue 5, April 2018 General Requirements for Compliance of Radio Apparatus
RSS-247	Issue 3, August 2023 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

4. TEST METHODOLOGY

Justification statement:
For antenna as stated in '**Timco**' newsletter for Part 15 applications with equipment classes DTS, which require the antenna gain for compliance with EIRP limits.

Radio performance tests procedures given in CFR 47 part 15:

Subpart C – Intentional Radiators
Paragraph 247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

Radio performance tests procedures given in RSS-247:
Paragraph 5 - Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

5. TEST EQUIPMENT CALIBRATION DATES

Emitech Number	Model	Type	Last calibration	Calibration interval (years)	Next calibration due
0	BAT-EMC V3.18.0.26	Software	/	/	/
5609	EMCO 3146A	Log periodic antenna	14/12/2021	3	14/12/2024
7564	La Crosse Technology WS-9232	Meteo station	09/06/2023	2	09/06/2025
7651	SIDT Cage	Anechoic chamber	/	/	/
10952	Agilent 34401A	Multimeter	21/07/2023	2	21/07/2025
11588	Rohde et Schwarz NRP-Z86	Power Sensor	07/03/2024	2	07/03/2026
12492	Weinschel 10dB 18GHz 2W	Attenuator	26/02/2024	3	26/02/2027
15775	RFPA INT-BA011000-25	Low-noise amplifier	29/02/2024	1	29/02/2025
15776	Rohde & Schwarz FSV40	Spectrum Analyzer	22/02/2024	1	22/02/2025
15892	HUBER et SUHNER N 18GHz 3m	Cable	31/05/2023	2	31/05/2025
15893	HUBER et SUHNER SMA 18GHz 3m	Cable	31/05/2023	2	31/05/2025
15916	HUBER et SUHNER SMA 18GHz 3.5m	Cable	31/05/2023	2	31/05/2025
15933	HUBER et SUHNER SMA 18GHz 5m	Cable	31/05/2023	2	31/05/2025
16115	Agilent 6655A	Power source	/	/	/

6. TESTS RESULTS SUMMARY

6.1 CFR 47 part 15requirements

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.247	OPERATION WITHIN THE BANDS 902-928 MHZ, 2400-2483.5 MHz and 5725-5850 MHz					
	(b) Maximum peak output power	X				Note 1
	(c) Operation with directional antenna gains > 6 dBi			X		

NAp: Not Applicable NAs: Not Asked

Note 1: First, a measurement was performed using the radiated method for each antennas, then a conducted measurement was performed .

Gain antenna is calculated by subtracting conducted power measurement from radiated power measurement.

6.2 RSS-247 requirements

Test Procedure RSS-247	Description of test	Criteria respected ?				Comment
		Yes	No	NAp	NAs	
Paragraph 5	Standard specifications for frequency hopping system and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz					
5.4	Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) requirements	X				Note 1

NAp: Not Applicable NAs: Not Asked

Note 1: First, a measurement was performed using the radiated method for each antennas, then a conducted measurement was performed .

Gain antenna is calculated by subtracting conducted power measurement from radiated power measurement.

7. MEASUREMENT UNCERTAINTY

To declare, or not, the compliance with the specifications, it was not explicitly taken into account of uncertainty associated with the result(s)

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%.

Parameter	Emitech Uncertainty
RF power, conducted	± 0.8dB
Radiated emission valid to 26 GHz 9kHz – 30MHz 30MHz – 1GHz 1GHz – 18GHz 18GHz – 40GHz	 ± 2.7. dB ± 5.0 dB ± 5.3 dB ± 6.1 dB
AC Power Lines conducted emissions	± 3.4 dB
Temperature	± 1 °C
Humidity	± 5 %

8. ANTENNA GAIN CALCULATION

Temperature (°C) : 20 to 28 **Humidity (%HR):** 37 to 45 **Date :** June 6, 2024 to June 8, 2024

Technician : T. LEDRESSEUR

Standard: FCC Part 15
RSS-247

Test procedure:
For FCC Part 15: paragraph 15.247 (b)
For RSS-247: paragraph 5.4
AVGPM-G method (using a gated RF average-reading power meter) of paragraph 11.9.2.3.2 of ANSI C63.10

Radiated Method Measurement:

First an exploratory radiated measurement was performed.

During this phase the product is oriented in three orthogonal planes.

Then the final measurement is realized with the product on the most critical orientation.

The EUT is placed on a rotating table, 0.8m from a ground plane
Zero degree azimuths correspond to the front of the device under test.

Distance of antenna: 10 meters (in open area test site)

Antenna height: 1 to 4 meters (in open area test site)

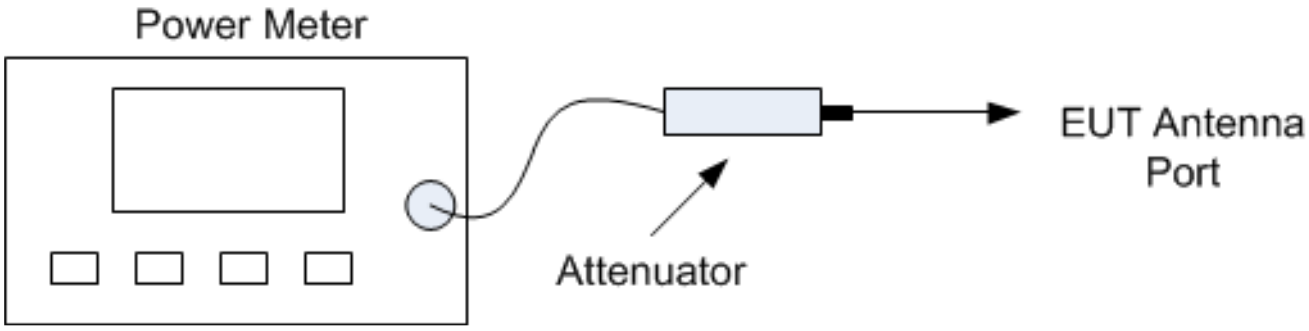
Antenna polarization: vertical and horizontal (only the highest level is recorded)

The measure with a calibrated gated RF average reading power meter.

Finally the radiated electro-magnetic field is converted in dBm with the following formula:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna with a Gain (unit in dBi) different following the frequencies used.

Conducted Method Measurement:

Conducted test



The measure is realized in conducted mode with a calibrated gated RF average reading power meter.

Equipment under test operating condition:

The equipment under test is blocked in continuous modulated transmission mode, at the highest output power level at which the transmitter is intended to operate.

Power source: 3.3 Vdc by an external power supply
Percentage of voltage variation during the test (%): ± 1

Results:

Sample N° 1 Channel F = 902.764 MHz- ½ λ whip antenna – Declared gain : +2.15 dBi

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 3.3Vdc	113.92	18.69	16.84	1.85

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 Channel F = 915.644 MHz - ½ λ whip antenna – Declared gain : +2.15 dBi

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 3.3Vdc	113.98	18.75	16.76	1.99

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 Channel F = 927.236 MHz - ½ λ whip antenna – Declared gain : +2.15 dBi

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 3.3Vdc	113.93	18.7	16.68	2.02

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Conclusion: The declared gain is in line with the measurements taken.

Sample N° 1 Channel F = 902.764 MHz- Omni-directional antenna – Declared gain : +3 dBi

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 3.3Vdc	114.92	19.69	16.84	2.85

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 Channel F = 915.644 MHz - Omni-directional antenna – Declared gain : +3 dBi

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 3.3Vdc	114.66	19.43	16.76	2.67

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 Channel F = 927.236 MHz - Omni-directional antenna – Declared gain : +3 dBi

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 3.3Vdc	114.88	19.65	16.68	2.97

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Conclusion: The declared gain is in line with the measurements taken.

Sample N° 1 Channel F = 902.764 MHz - Patch antenna (PCB) – Declared gain : +1.9 dBi

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 3.3Vdc	114.05	18.82	16.84	1.98

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 Channel F = 915.644 MHz - Patch antenna (PCB) – Declared gain : +1.9 dBi

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 3.3Vdc	113.86	18.63	16.76	1.87

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 Channel F = 927.236 MHz - Patch antenna (PCB) – Declared gain : +1.9 dBi

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 3.3Vdc	113.48	18.25	16.68	1.57

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Conclusion: The declared gain is in line with the measurements taken.

Sample N° 1 Channel F = 902.764 MHz - Internal ceramic antenna – Declared gain : +2.15 dBi

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 3.3Vdc	114.28	19.05	16.84	2.21

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 Channel F = 915.644 MHz - Internal ceramic antenna – Declared gain : +2.15 dBi

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 3.3Vdc	114.25	19.02	16.76	2.26

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 Channel F = 927.236 MHz - Internal ceramic antenna – Declared gain : +2.15 dBi

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 3.3Vdc	113.58	18.35	16.68	1.67

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Conclusion: The declared gain is in line with the measurements taken.

□□□ End of report □□□